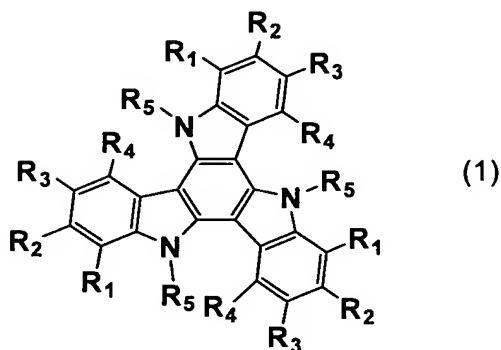


Claims

[1] A substituted Sym-triindole derivative represented by the following general formula (1)

[formula 1]

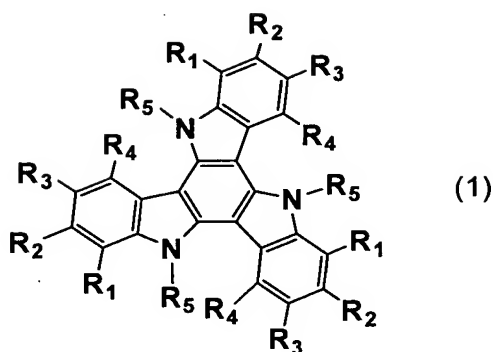


5 (wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are each independently hydrogen, halogen, C1-C6 alkyl group, C1-C6 haloalkyl group, substituted C1-C6 alkyl group, C2-C6 alkenyl group, substituted C2-C6 alkenyl group, C2-C6 alkynyl group, substituted C2-C6 alkynyl group, hydroxyl group, C1-C6 alkoxy group, aryloxy  
10 group, amino group, mono-substituted amino group, di-substituted amino group, acylamino group, mercapto group, C1-C6 alkylsulfenyl group, C1-C6 haloalkylsulfenyl group, arylsulfenyl group, substituted arylsulfenyl group, C1-C6 alkylsulfinyl group, C1-C6 haloalkylsulfinyl group, aralkylsulfenyl group, arylsulfinyl group, substituted arylsulfinyl  
15 enyl group, arylsulfinyl group, substituted arylsulfinyl

group, C1-C6 alkylsulfonyl group, C1-C6 haloalkylsulfonyl group, arylsulfonyl group, substituted arylsulfonyl group, sulfonic acid group (hydroxysulfonyl group), aryl group, substituted aryl group, cyano group, nitro group, formyl group, acyl group, carboxyl group, C1-C6 alkoxy carbonyl group, carbamoyl group, N-mono-substituted carbamoyl group, N,N-disubstituted carbamoyl group, hydrazonomethyl group ( $-\text{CH}=\text{N}-\text{NH}_2$  group), N-mono-substituted hydrazonomethyl group, N,N-disubstituted hydrazonomethyl group, oximemethyl group (hydroxyiminomethyl group), C1-C6 alkoxyiminomethyl group, or aryloxyiminomethyl group;  $\text{R}_5$  is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group, or aryl C1-C6 alkyl group; in no event, all of  $\text{R}_1$ ,  $\text{R}_2$ ,  $\text{R}_3$  and  $\text{R}_4$  are hydrogen simultaneously).

[2] A process for producing a substituted Sym-triindole derivative represented by the following general formula (1)

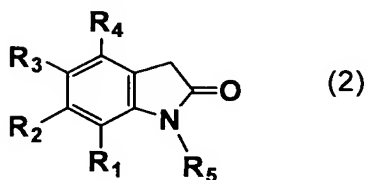
[formula 3]



(wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are each independently hydrogen, halogen, C1-C6 alkyl group, C1-C6 haloalkyl group, substituted C1-C6 alkyl group, C2-C6 alkenyl group, substituted C2-C6 alkenyl group, C2-C6 alkynyl group, substituted C2-C6 alkynyl group, hydroxyl group, C1-C6 alkoxy group, aryloxy group, amino group, mono-substituted amino group, di-substituted amino group, acylamino group, mercapto group, C1-C6 alkylsulfenyl group, C1-C6 haloalkylsulfenyl group, aralkylsulfenyl group, arylsulfenyl group, substituted arylsulfenyl group, C1-C6 alkylsulfinyl group, C1-C6 haloalkylsulfinyl group, arylsulfinyl group, substituted arylsulfinyl group, C1-C6 alkylsulfonyl group, C1-C6 haloalkylsulfonyl group, arylsulfonyl group, substituted arylsulfonyl group, sulfonic acid group (hydroxysulfonyl group), aryl group, substituted aryl group, cyano group, nitro group, formyl group,

acyl group, carboxyl group, C1-C6 alkoxy carbonyl group, carbamoyl group, N-mono-substituted carbamoyl group, N,N-disubstituted carbamoyl group, hydrazonomethyl group ( $-\text{CH}=\text{N}-\text{NH}_2$  group), N-mono-substituted hydrazonomethyl group, N,N-disubstituted hydrazonomethyl group, oximemethyl group (hydroxyiminomethyl group), C1-C6 alkoxyiminomethyl group, or aryloxyiminomethyl group;  $\text{R}_5$  is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group, or aryl C1-C6 alkyl group; in no event, all of  $\text{R}_1$ ,  $\text{R}_2$ ,  $\text{R}_3$  and  $\text{R}_4$  are hydrogen simultaneously), which process comprises reacting a substituted oxyindole represented by the following general formula (2)

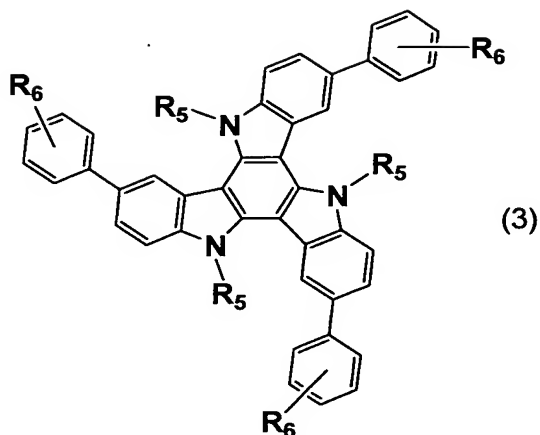
[formula 2]



(wherein  $\text{R}_1$ ,  $\text{R}_2$ ,  $\text{R}_3$ ,  $\text{R}_4$  and  $\text{R}_5$  have the same definitions as given above) with a phosphorus oxyhalide.

[3] A Sym-triindole derivative represented by the following general formula (3)

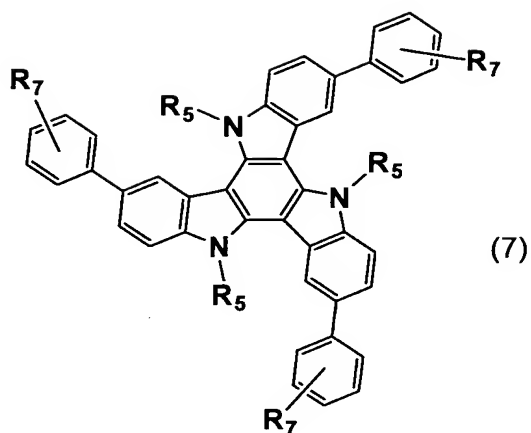
[formula 4]



(wherein R<sub>5</sub> is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group, or aryl C1-C6 alkyl group; and R<sub>6</sub> is hydrogen, formyl group, cyano group, C1-C6 alkoxy-  
 5 carbonyl group, dicyanovinyl group, aryl group or substituted aryl group).

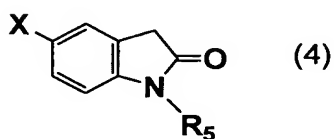
[4] A process for producing a Sym-triindole derivative represented by the following general formula (7)

[formula 8]



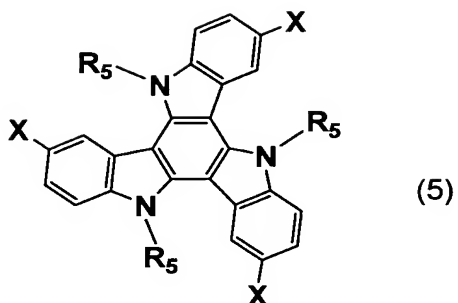
(wherein  $R_5$  is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and  $R_7$  is hydrogen, formyl group, cyano group, C1-C6 alkoxy-carbonyl group, aryl group or substituted aryl group), which  
 5 process comprises reacting an N-substituted-5-halo-oxyindole represented by the following general formula (4)

[formula 5]



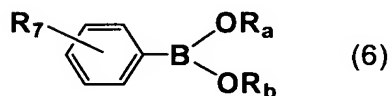
(wherein  $R_5$  has the same definition as given above; and X is halogen) with a phosphorus oxyhalide to obtain an N-substituted-5-halo-triindole derivative represented by the  
 10 following general formula (5)

[formula 6]



(wherein R<sub>5</sub> and X have the same definitions as given above)  
and further reacting it with a boric acid compound represented by the following general formula (6)

[formula 7]

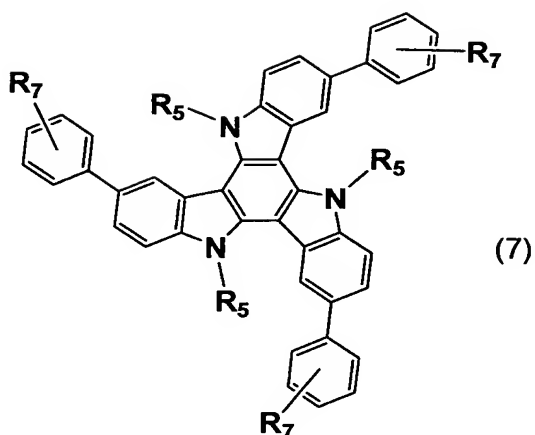


5 (wherein R<sub>7</sub> has the same definition as give above; and R<sub>a</sub> and R<sub>b</sub> are each independently hydrogen atom, C1-C6 alkyl group or optionally substituted phenyl group and may be combined to each other to form a ring).

[5] A process for producing a Sym-triindole derivative represented by the following general formula (7)

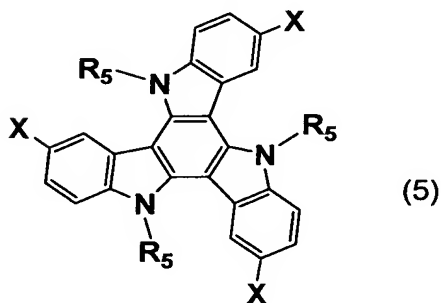
10

[formula 11]



(wherein  $R_5$  is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and  $R_7$  is hydrogen, formyl group, cyano group, C1-C6 alkoxy-carbonyl group, aryl group or substituted aryl group), which  
 5 process comprises reacting an N-substituted-5-halo-triindole derivative represented by the following general formula (5)

[formula 9]

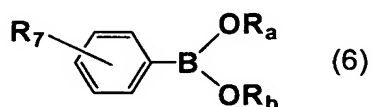


(wherein  $R_5$  has the same definition as given above; and X is halogen) with a boric acid compound represented by the fol-



lowing general formula (6)

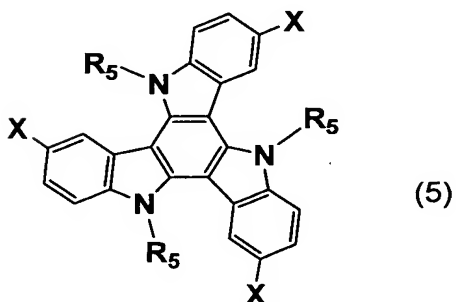
[formula 10]



(wherein  $R_7$  has the same definition as given above; and  $R_a$  and  $R_b$  are each independently hydrogen atom, C1-C6 alkyl group or optionally substituted phenyl group and may be combined to each other to form a ring).

[6] A process for producing an N-substituted-5-halo-triindole derivative represented by the following general formula (5)

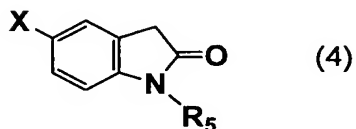
10 [formula 13]



(wherein  $R_5$  is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and X is halogen), which process comprises reacting an N-

substituted-5-halo-oxyindole represented by the following  
general formula (4)

[formula 12]

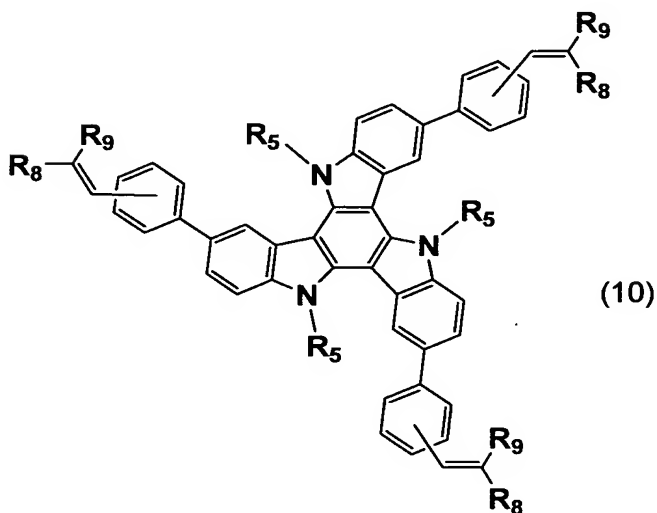


(wherein R<sub>5</sub> and X have the same definitions as given above)

5 with a phosphorus oxyhalide.

[7] A process for producing a Sym-triindole derivative represented by the following general formula (10)

[formula 16]

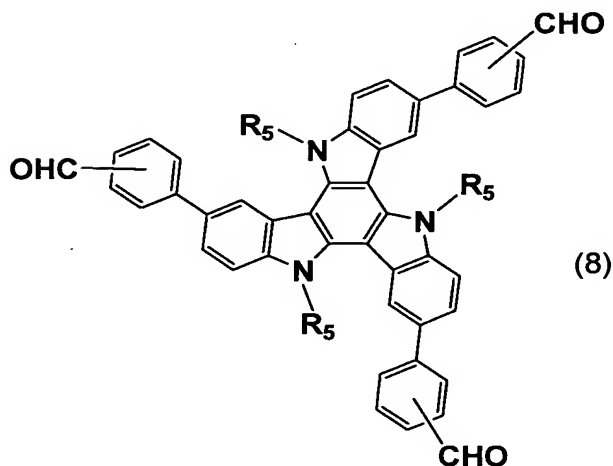


(wherein R<sub>5</sub> is C2-C12 alkyl group, substituted C2-C12 alkyl  
10 group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; R<sub>8</sub>

is hydrogen or cyano group; and R<sub>9</sub> is cyano group, carboxylic acid group, C1-C6 alkoxy carbonyl group, aryl group or substituted aryl group), which process comprises reacting a triindole derivative represented by the following general formula

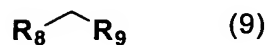
5 (8)

[formula 14]



(wherein R<sub>5</sub> has the same definition as given above) with a methylene compound represented by the general formula (9)

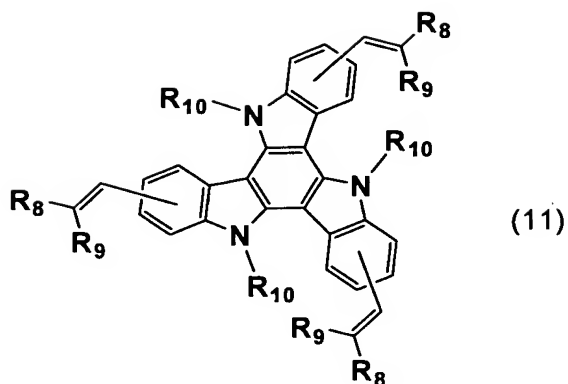
[formula 15]



10 (wherein R<sub>8</sub> and R<sub>9</sub> have the same definitions as give above).

[8] A Sym-triindole vinyl derivative represented by the following general formula (11)

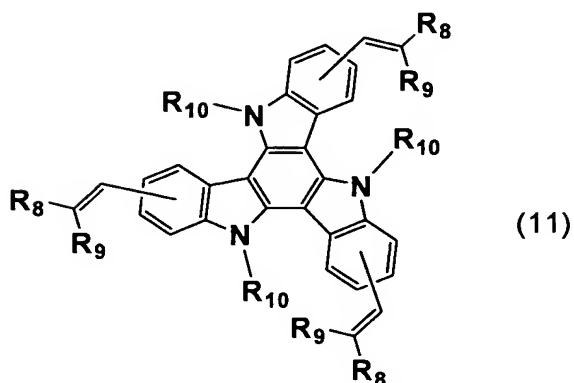
[formula 17]



(wherein  $R_8$  is hydrogen or cyano group;  $R_9$  is cyano group, carboxylic acid group, C1-C6 alkoxy carbonyl group, aryl group or substituted aryl group; and  $R_{10}$  is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or  
 5 aryl C1-C6 alkyl group).

[9] A process for producing a Sym-triindole derivative represented by the following general formula (11)

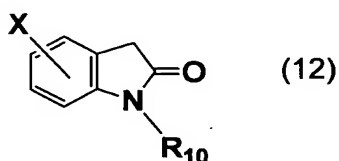
[formula 22]



(wherein  $R_8$  is hydrogen or cyano group;  $R_9$  is cyano group,

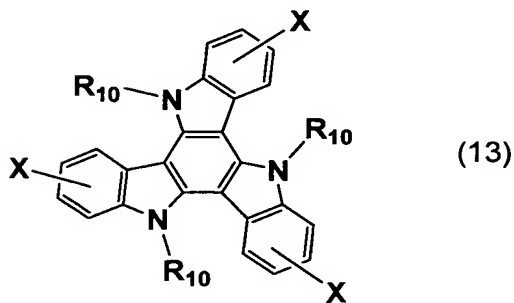
carboxylic acid group, C1-C6 alkoxy carbonyl group, aryl group or substituted aryl group; and R<sub>10</sub> is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group), which process comprises reacting an  
 5 oxyindole compound represented by the following general formula (12)

[formula 18]



(wherein R<sub>10</sub> has the same definition as given above and X is halogen) with a phosphorus oxyhalide to obtain a Sym-halo-  
 10 triindole derivative represented by the following general formula (13)

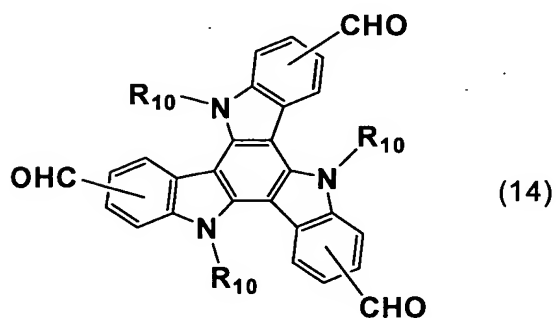
[formula 19]



(wherein R<sub>10</sub> and X have the same definitions as given above),

subjecting it to formylation with a formylating agent in the presence of butyllithium to obtain a Sym-formyltriindole derivative represented by the following general formula (14)

[formula 20]



5 (wherein  $R_{10}$  has the same definition as given above), and reacting it with a methylene compound represented by the following general formula (9)

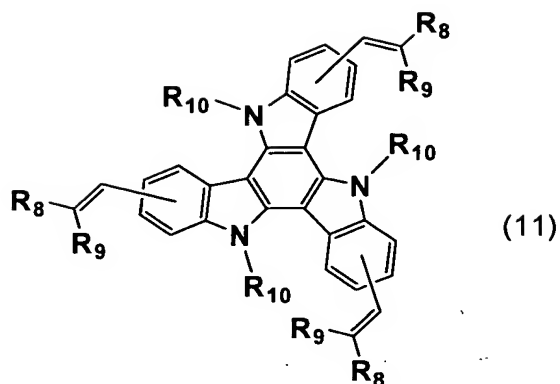
[formula 21]



(wherein  $R_8$  and  $R_9$  have the same definitions as given above).

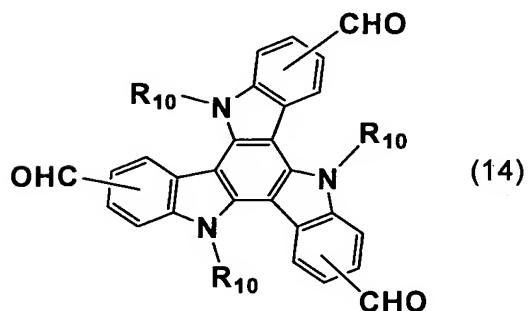
10 [10] A process for producing a Sym-triindole derivative represented by the following general formula (11)

[formula 25]



(wherein R<sub>8</sub> is hydrogen or cyano group; R<sub>9</sub> is cyano group, carboxylic acid group, C1-C6 alkoxy carbonyl group, aryl group or substituted aryl group; and R<sub>10</sub> is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or  
 5 aryl C1-C6 alkyl group), which process comprises reacting a Sym-formyltriindole derivative represented by the following general formula (14)

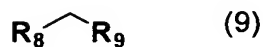
[formula 23]



(wherein R<sub>10</sub> has the same definition as given above) with a  
 10 methylene compound represented by the following general for-

mula (9)

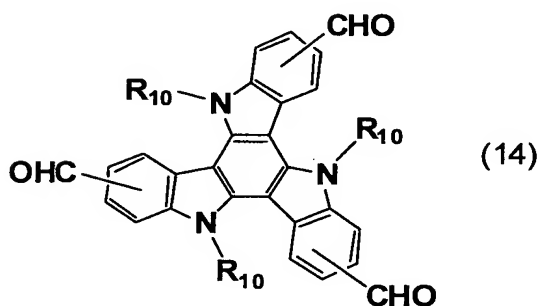
[formula 24]



(wherein R<sub>8</sub> and R<sub>9</sub> have the same definitions as given above).

[11] A process for producing a Sym-formyltriindole deriva-  
5 tive represented by the following general formula (14)

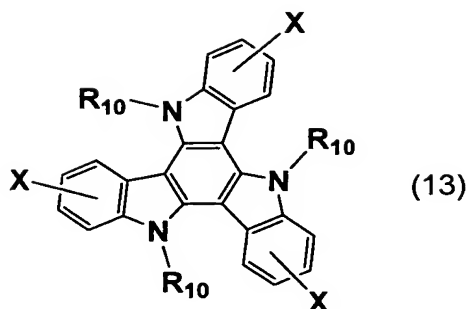
[formula 27]



(wherein R<sub>10</sub> is C2-C12 alkyl group, C2-C12 substituted alkyl  
group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group),  
which process comprises subjecting a Sym-halo-triindole de-  
10 rivative represented by the following general formula (13)

[formula 26]

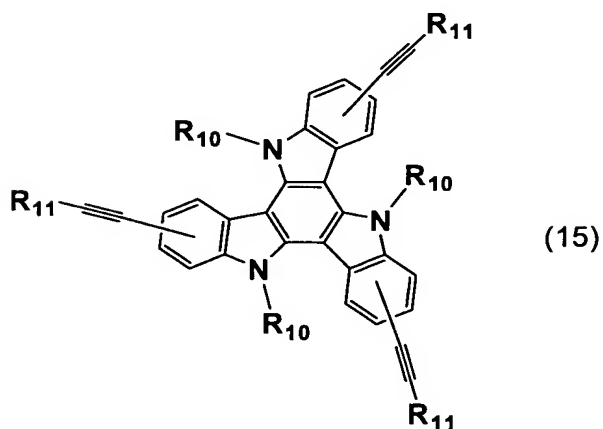




(wherein R<sub>10</sub> has the same definition as given above and X is halogen), to formylation with a formylating agent in the presence of butyllithium.

[12] A Sym-triindole derivative represented by the following  
 5 general formula (15)

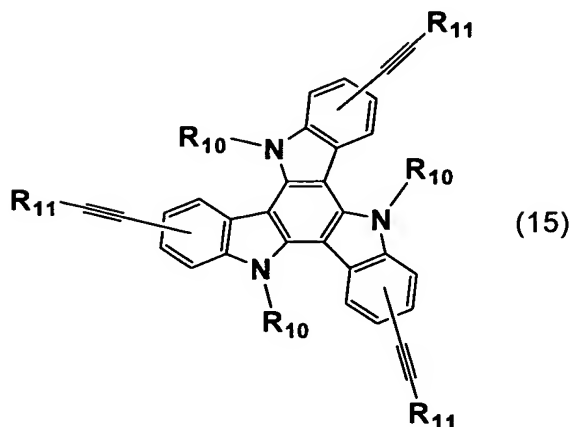
[formula 28]



(wherein R<sub>10</sub> is C<sub>2</sub>-C<sub>12</sub> alkyl group, C<sub>2</sub>-C<sub>12</sub> substituted alkyl group, C<sub>2</sub>-C<sub>12</sub> haloalkyl group or aryl C<sub>1</sub>-C<sub>6</sub> alkyl group; and R<sub>11</sub> is aryl group or substituted aryl group).

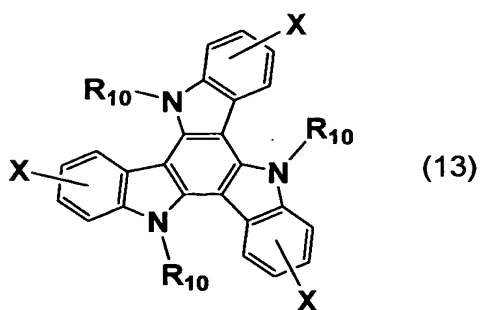
[13] A process for producing a Sym-triindole derivative represented by the following general formula (15)

[formula 31]



(wherein R<sub>10</sub> is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and R<sub>11</sub> is aryl group or substituted aryl group), which process comprises reacting a Sym-halo-triindole derivative represented by the following general formula (13)

[formula 29]



(wherein  $R_{10}$  has the same definition as given above and X is halogen) with an acetylene derivative represented by the following general formula (16)

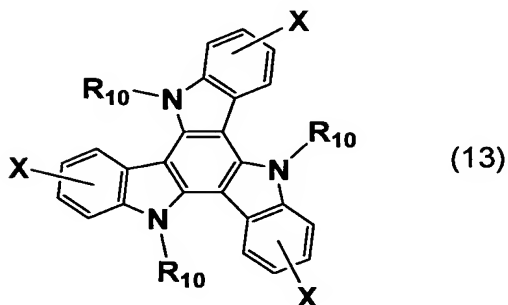
[formula 30]



5 (wherein  $R_{11}$  has the same definition as given above and  $R_{12}$  is hydrogen or trimethylsilyl group).

[14] A Sym-halo-triindole derivative represented by the following general formula (13)

[formula 32]



10 (wherein  $R_{10}$  is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and X is halogen).